Arab Gulf Journal of Scientific Research 1997 vol.15 N2, pages 325-351

Analytical solutions to a problem of sink-source flow in a porous medium

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Abstract

New analytical solution to the problem of fluid flow in a porous reservoir composed by rectangular blocks is presented. The Muskat linear, five-point, and chess-type patterns of injection-extraction wells (IEW) are obtained as special cases of this solution. Streamlines, isochrones, breakthrough curves are evaluated in terms of the model of pure advection. Effective conductivity of these patterns is obtained explicitly and compared with Muskat's values which occurred to be good approximations of the rigorous formulae. Numerical procedure of particle tracking is verified on the Rankine flow pattern for a pair of IEW placed in an uniform groundwater flow and the Polubarinova-Kochina solution for a pumping well in an aquifer with a circular inhomogeneity. Applications to a network of octogonal honey-comb blocks and filled fractures-orifices are discussed.